300mA, High PSRR, Dual Output Low-Dropout Regulator

Description

The FP6121 is a dual output, low dropout, high PSRR, low quiescent current linear regulators. The FP6121 can supply 200mA output current with a lower dropout voltage about 300mV for each channel.

The FP6121 is suitable for portable and wireless application such as mobile phone and portable hand-sets. The FP6121 is designed and optimized to work with low-value, low cost ceramic capacitors. The FP6121 consumes less than 0.1μA during shutdown mode which is independent for each channel, allowing for flexibility in power management. Besides its current limit protection and on chip thermal shutdown features provide protection against any combination of overload or ambient temperature that could exceed junction temperature.

The FP6121 doesn't need external bypass capacitor and still could get better noise performance. The tiny SOT-23-6, TSOT-23-6 and TDFN-6 packages are attractive for hand-held applications.

Features

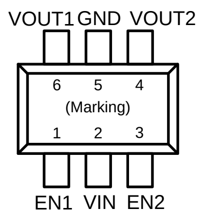
- Low Dropout Voltage: 300mV at I_{OUT}=200mA
- Guaranteed 300mA Output Current Per Channel
- Very Low Quiescent Current: 25μA
- High Power Supply Rejection Ratio: 70dB at 10kHz
- Highly Accurate: ±2%
- Needs Only 1μF Ceramic Capacitor for Stability
- Thermal Shutdown and Current Limiting Protection
- Tiny SOT-23-6, TSOT-23-6 and TDFN-6 Packages
- RoHS Compliant

Applications

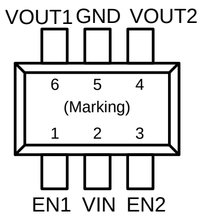
- Mobile Phone
- Portable or Wireless Instrument
- Camera
- PDA and Notebook Computer

Pin Assignment

S6 Package (SOT-23-6)



S9 Package (TSOT-23-6)



WD Package (TDFN-6) (1.6mm×1.6mm)

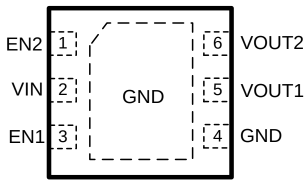
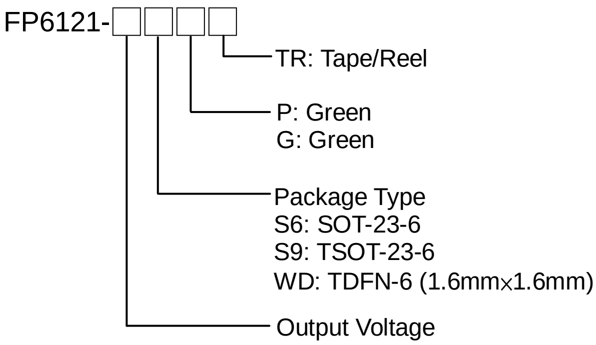


Figure 1. Pin Assignment of FP6121

Ordering Information



	VOUT1	VOUT2		VOUT1	VOUT2
A	3.3V	2.8V	L	1.8V	2.6V
B	3.3V	2.5V	M	1.8V	3.0V
C	2.8V	1.8V	N	2.8V	3.3V
D	2.5V	1.8V	O	1.8V	1.8V
E	3.0V	1.8V	P	2.85V	2.85V
F	1.8V	2.8V	Q	1.5V	3.0V
G	2.8V	2.8V	R	1.5V	3.3V
H	1.5V	2.8V	S	1.2V	3.3V
I	1.8V	3.3V	T	3.0V	2.85V
J	1.3V	2.8V	V	3.3V	3.3V
K	1.2V	2.8V	W	1.2V	1.8V

TSOT-23-6 Marking

Part Number	Product Code	Part Number	Product Code
FP6121-AS9P	fR	FP6121-JS9P	fm
FP6121-BS9P	fS	FP6121-KS9G	frG
FP6121-CS9P	fT	FP6121-KS9P	fr
FP6121-DS9P	fU	FP6121-LS9P	fv
FP6121-ES9P	fV	FP6121-MS9P	fw
FP6121-FS9G	fW	FP6121-NS9P	FM
FP6121-GS9P	fX	FP6121-OS9P	FN
FP6121-HS9P	fY	FP6121-PS9P	FU
FP6121-IS9G	fiG	FP6121-QS9G	D4G
FP6121-IS9P	fi	FP6121-QS9P	B5G

TDFN-6 (1.6mm×1.6mm) Marking

Part Number	Product Code	Part Number	Product Code
FP6121-AWDG	0	FP6121-LWDG	M
FP6121-BWDG	B	FP6121-MWDG	N
FP6121-CWDG	C	FP6121-NWDG	P
FP6121-DWDG	D	FP6121-OWDG	R.
FP6121-EWDG	E	FP6121-PWDG	S.
FP6121-FWDG	F	FP6121-QWDG	T.
FP6121-GWDG	G	FP6121-RWDG	U.
FP6121-HWDG	H	FP6121-SWDG	X.
FP6121-IWDG	J	FP6121-TWDG	V.
FP6121-JWDG	K	FP6121-VWDG	W.
FP6121-KWDG	L		

SOT-23-6 Marking

Part Number	Product Code	Part Number	Product Code
FP6121-AS6P	fA	FP6121-KS6P	fn
FP6121-AS6G	fA=	FP6121-KS6G	fn=
FP6121-BS6P	fB	FP6121-LS6P	ft
FP6121-BS6G	fB=	FP6121-LS6G	ft=
FP6121-CS6P	fC	FP6121-MS6P	fu
FP6121-CS6G	fC=	FP6121-MS6G	fu=
FP6121-DS6P	fD	FP6121-NS6P	FK
FP6121-DS6G	fD=	FP6121-NS6G	FK=
FP6121-ES6P	fE	FP6121-OS6P	FL
FP6121-ES6G	fE=	FP6121-OS6G	FL=
FP6121-FS6P	fF	FP6121-PS6P	FT
FP6121-FS6G	fF=	FP6121-PS6G	FT=
FP6121-GS6P	fG	FP6121-QS6P	F0
FP6121-GS6G	fG=	FP6121-QS6G	F0=
FP6121-HS6P	fH	FP6121-RS6G	B3=
FP6121-HS6G	fHG	FP6121-SS6G	L1=
FP6121-IS6P	fZ	FP6121-TS6G	G7=
FP6121-IS6G	fZ=	FP6121-VS6G	D9=
FP6121-JS6P	fk	FP6121-VS6P	D9
FP6121-JS6G	fk=	FP6121-WS6G	F0G

Typical Application Circuit

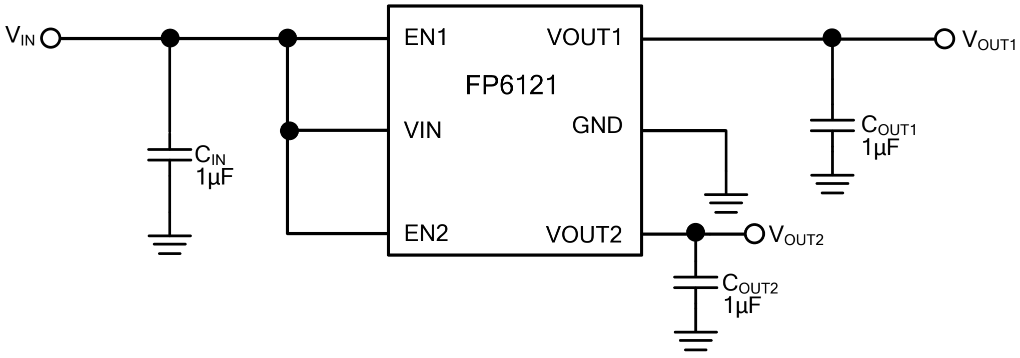


Figure 2. Typical Application Circuit of FP6121

Note : To prevent oscillation, it is recommended to use minimum 1µF X7R or X5R dielectric capacitors if ceramics are used as input/output capacitors.

Functional Pin Description

Pin Name	Pin Function
VIN	Power is supplied to this device from this pin which requires an input filter capacitor. In general, the input capacitor in the range of 1µF to 10µF is sufficient.
VOUT1	The output supplies power to loads. The output capacitor is required to prevent output voltage unstable. The FP6121 is stable with an output capacitor 1µF or greater. The larger output capacitor will be required for application with large transit load to limit peak voltage transits, besides could reduce output noise, improve stability and PSRR.
VOUT2	The output supplies power to loads. The output capacitor is required to prevent output voltage unstable. The FP6121 is stable with an output capacitor 1µF or greater. The larger output capacitor will be required for application with large transit load to limit peak voltage transits, besides could reduce output noise, improve stability and PSRR.
GND	Common ground pin
EN1	Logic input control VOUT1 active or shut off. The enable pin can't be left floating and must be tied to the Vin pin if not used. The shutdown mode which is independent for each channel, allowing for flexibility in power management.
EN2	Logic input control VOUT2 active or shut off. The enable pin can't be left floating and must be tied to the Vin pin if not used. The shutdown mode which is independent for each channel, allowing for flexibility in power management.

Absolute Maximum Ratings

- Supply Input Voltage (VIN) ---------- +6V
- Other Pin Voltage (EN1, EN2, VOUT1, VOUT2) ---------- +6V
- Maximum Junction Temperature (T_J) ---------- +150ºC
- Power Dissipation @25ºC, (P_D)
  - SOT-23-6, TSOT-23-6 ---------- +0.4W
  - TDFN-6 (1.6mm×1.6mm) ---------- +0.63W
- Package Thermal Resistance, (θ_{JA})
  - SOT-23-6,TSOT-23-6 ---------- +250ºC/W
  - TDFN-6 (1.6mm×1.6mm) ---------- +160ºC/W
- Storage Temperature Range (T_S) ---------- -65ºC to +150ºC
- Lead Temperature (Soldering, 10 sec.) (T_{LEAD}) ---------- +260ºC

Note1：Stresses beyond those listed under “Absolute Maximum Ratings" may cause permanent damage to the device.

Recommended Operating Conditions

- Input Voltage (V_{IN}) ---------- +2.0V to +5.5V
- Operating Temperature Range (T_{OPR}) ---------- -40ºC to +85ºC

Block Diagram

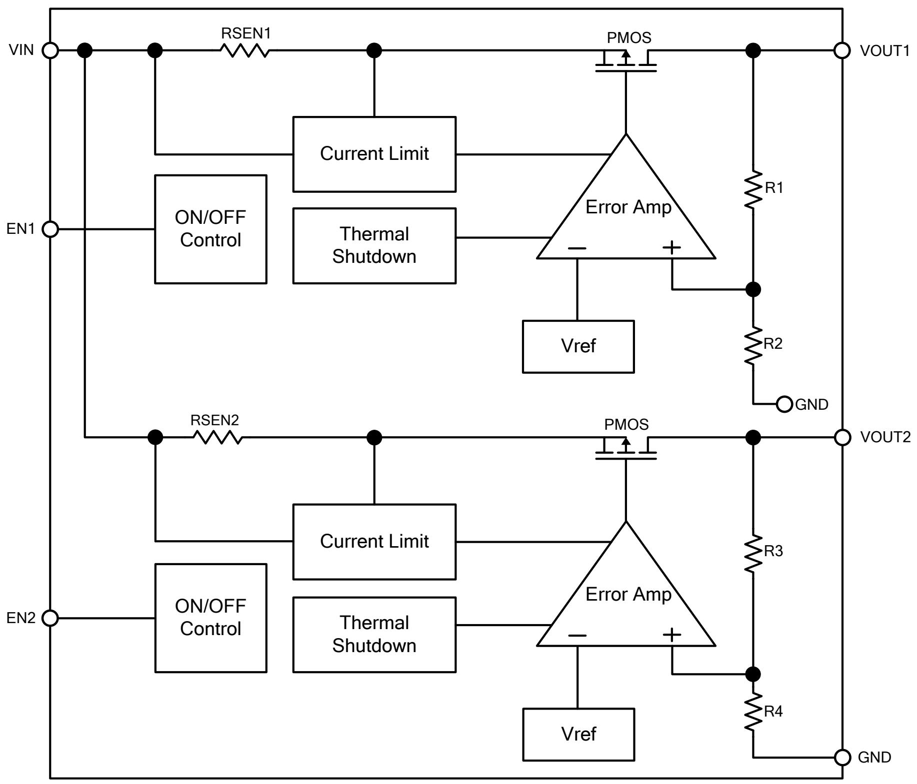


Figure 3. Block Diagram of FP6121

Electrical Characteristics

(V_{IN}=V_{OUT}+1V, V_{EN1}=V_{EN2}=V_{IN}, C_{IN}=1µF, C_{OUT}=1µF, T_A=25ºC, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage Accuracy		I_{OUT}=1mA		-2		+2	%
Current Limit	I_{LIMIT}	R_{Load}=1Ω		300			mA
Quiescent Current	I_Q	I_{OUT}=0mA (Single Channel)			25	50	µA
Dropout Voltage (Note2)	V_{DROP}	I_{OUT}=150mA	V_{OUT}=1.5V		910	1100	mV
			V_{OUT}=1.8V		750	900	
			V_{OUT}=2.5V		500	600	
			V_{OUT}=3.0V		270	330	
			V_{OUT}=3.3V		230	270	
		I_{OUT}=300mA	V_{OUT}=1.5V		1600	1920	
			V_{OUT}=1.8V		1450	1750	
			V_{OUT}=2.5V		980	1170	
			V_{OUT}=3.0V		510	610	
			V_{OUT}=3.3V		400	480	
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	I_{OUT}=1mA, V_{IN}=V_{OUT} +1V to 5V			0.01	0.20	% / V
Load Regulation (Note3)	ΔV_{OUT}	I_{OUT}=1mA to 200mA			25	60	mV
Ripple Rejection (Note4)	PSRR	V_{IN}=V_{OUT}+1V f_{RIPPLE} = 10kHz			70		dB
Output Noise Voltage (Note4)	V_{NO}	C_{OUT}=1µF, I_{OUT}=0mA			30		µV_{RMS}
Standby Current	I_{STBY}	V_{EN1}=V_{EN2}=GND, Shutdown				1	µA
EN Input Bias Current	I_{IB}	V_{EN1}=V_{EN2}=V_{IN} or GND				100	nA
EN "High" Threshold	V_{IH}	Start-up		1.0			V
EN "Low" Threshold	V_{IL}	Shutdown				0.4	V
Temperature Coefficient (Note4)	T_C	I_{OUT}=1mA, V_{IN}=5V			100		ppm/ºC
Thermal Shutdown Temperature (Note4)	T_{SD}				160		ºC
	ΔT_{SD}	Hysteresis			25		ºC

Note 2：The dropout voltage is defined as V_{IN}-V_{OUT}, which is measured when V_{OUT} drops 2% of its normal value with the specified output current.

Note 3：Load regulation and dropout voltage are measured at a constant junction temperature by using a 40ms low duty cycle current pulse.

Note 4：Guarantee by design.

Typical Performance Curves

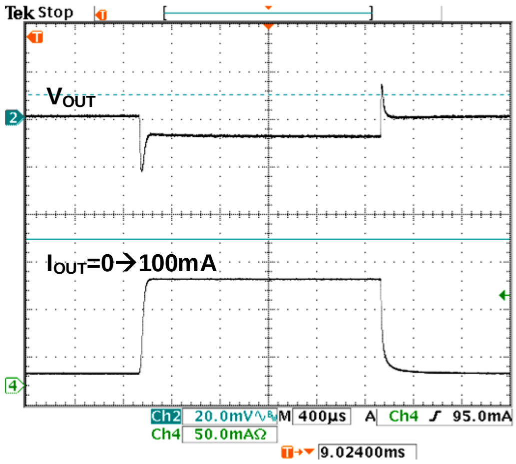


Figure 4. Load Transition Response
(V_{IN}=2.8V, V_{OUT}=1.8V)

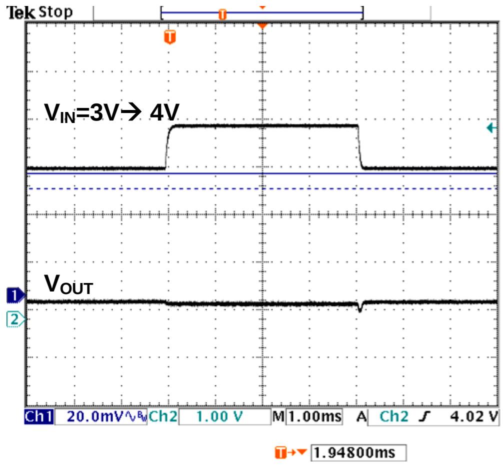


Figure 5. Line Transition Response
(V_{OUT}=1.8V, I_{OUT}=10mA)

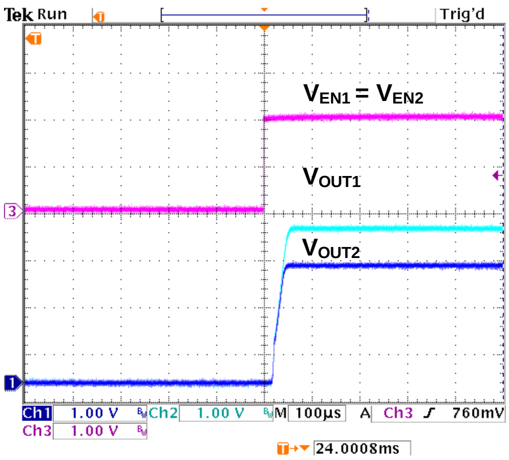


Figure 6. Enable Test
(V_{IN}=4V, V_{OUT1}=3.3V, V_{OUT2}=2.8V, I_{OUT}=30mA)

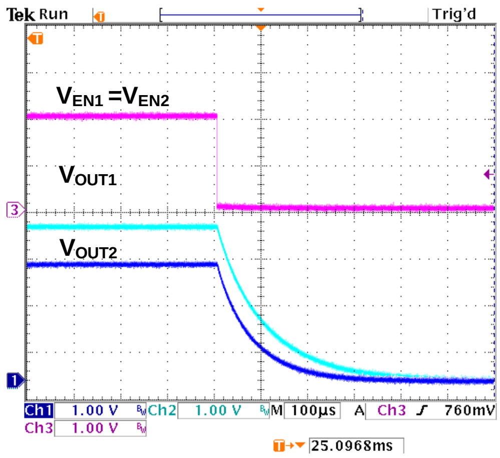


Figure 7. Shutdown Test
(V_{IN}=4V, V_{OUT1}=3.3V, V_{OUT2}=2.8V, I_{OUT}=30mA)

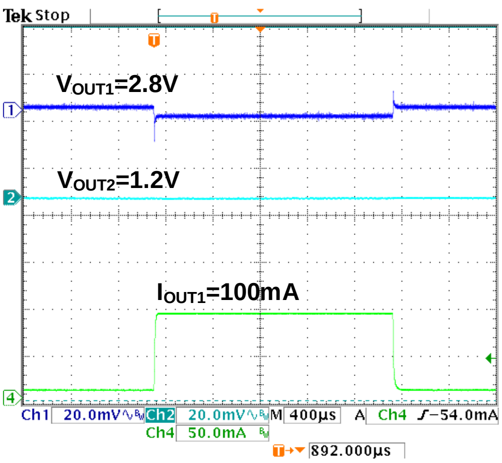


Figure 8. Dual Channel Crosstalk Test

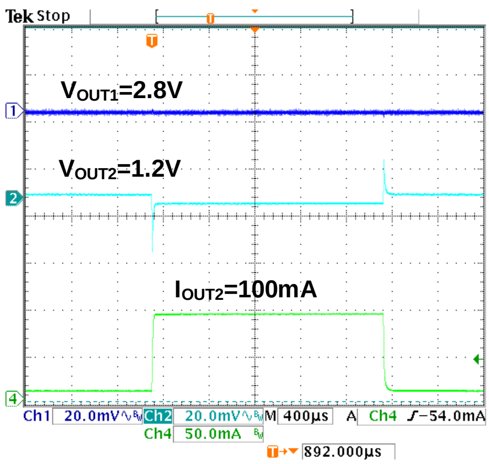


Figure 9. Dual Channel Crosstalk Test

Typical Performance Curves (Continued)

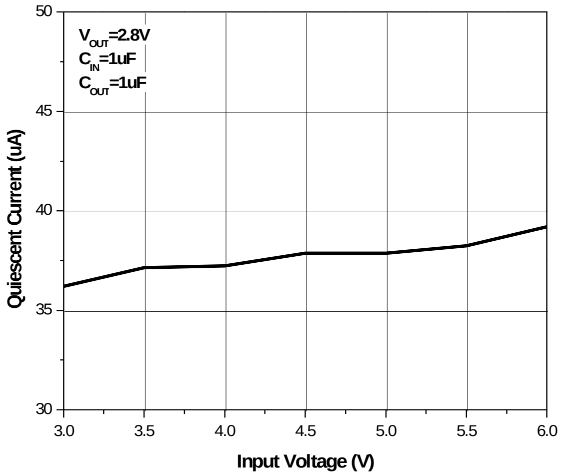


Figure 10. Quiescent Current vs. Input Voltage

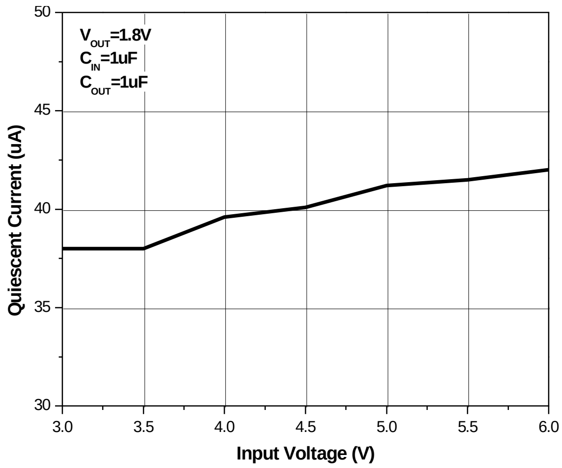


Figure 11. Quiescent Current vs. Input Voltage

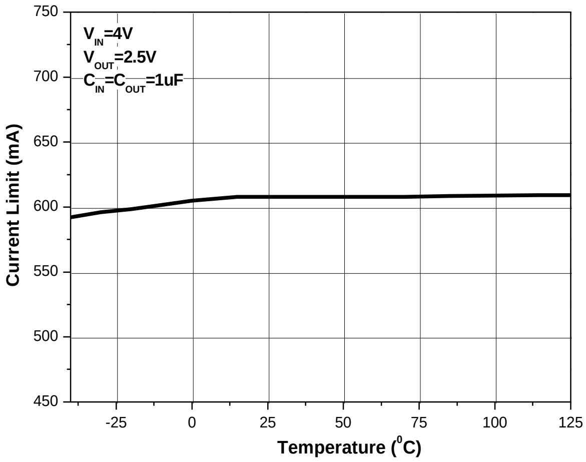


Figure 12. Current Limit vs. Temperature

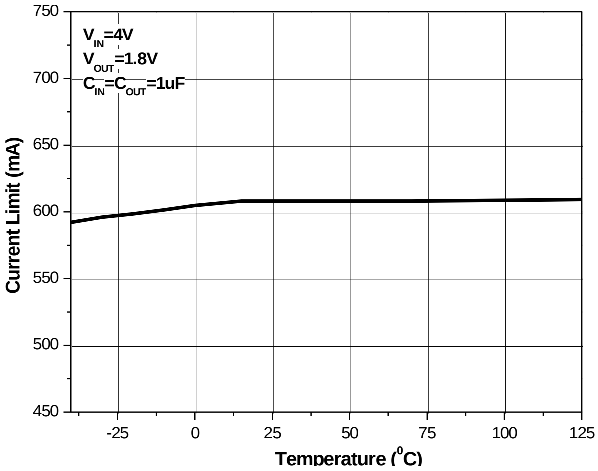


Figure 13. Current Limit vs. Temperature

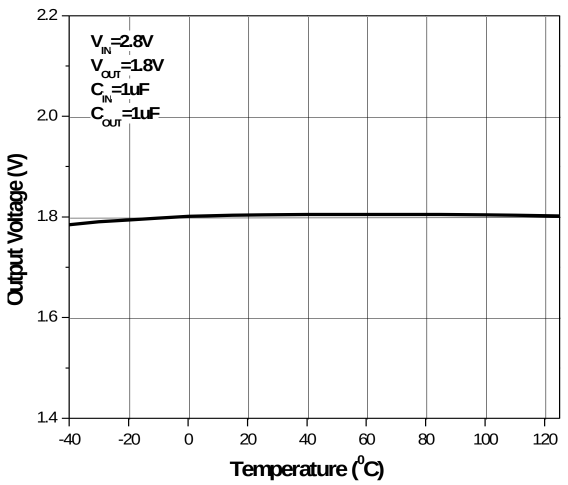


Figure 14. Output Voltage vs. Temperature

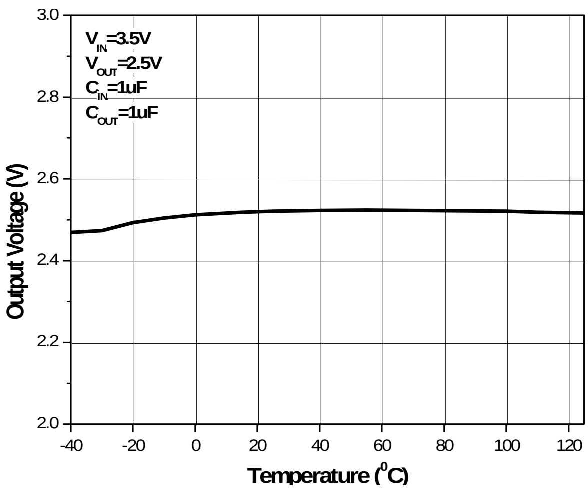


Figure 15. Output Voltage vs. Temperature

Typical Performance Curves (Continued)

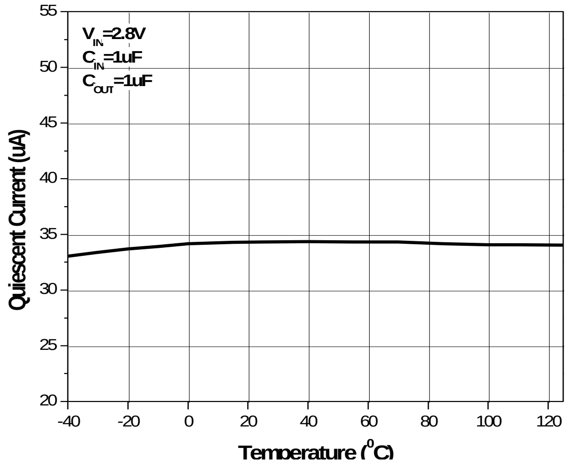


Figure 16. Quiescent Current vs. Temperature (V_{IN}=2.8V, V_{OUT}=1.8V)

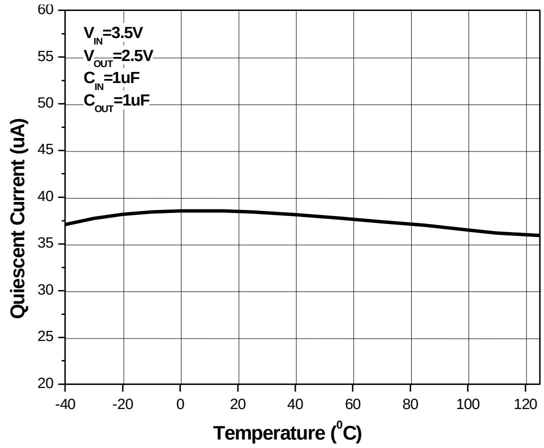


Figure 17. Quiescent Current vs. Temperature (V_{IN}=3.5V, V_{OUT}=2.5V)

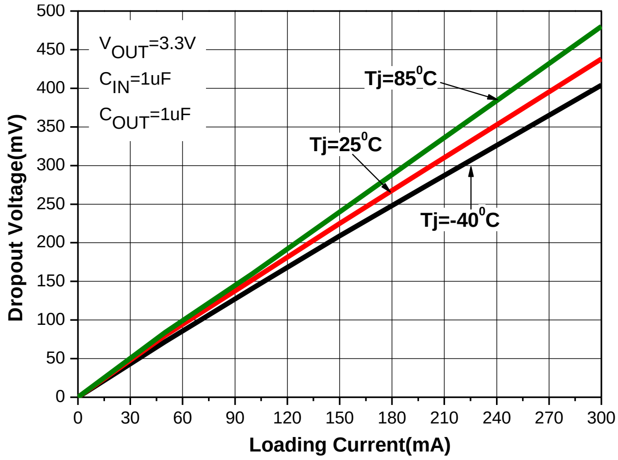


Figure 18. V_{OUT}=3.3V Dropout vs. Temperature

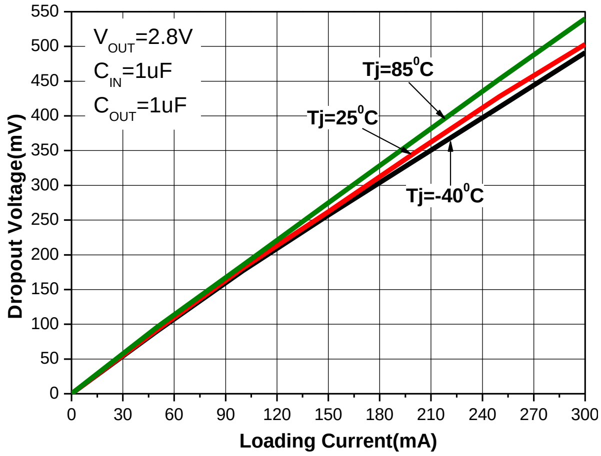


Figure 19. V_{OUT}=2.8V Dropout vs. Temperature

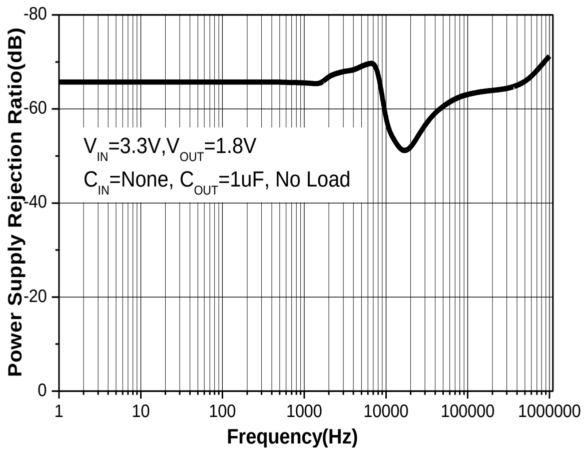


Figure 20. Power Supply Rejection Ratio vs. Frequency

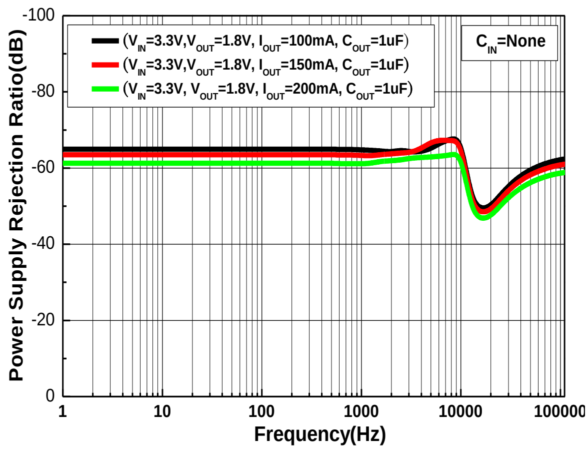


Figure 21. Power Supply Rejection Ratio vs. Frequency

Application Information

The FP6121 include 2 independent output channels. Current limit and on chip thermal shutdown features provide protection against any combination of overload or ambient temperature that could exceed maximum junction temperature.

EN Control

Force EN pin high to enable the FP6121 and turned off the device by pulling it low. The EN pin can't be floated and must be tied to the Vin if not used. The enable control is independent to each channel.

PSRR (Power Supply Rejection Ratio)

The FP6121 has high 70dB PSRR. Ripple rejection is the ability of the regulator to reduce input voltage ripple. It is specified with a 10kHz and $1V_{P-P}$ signal applying to input, with 1μF output capacitor. Ripple rejection, expressed in dB, is the ratio of output ripple to input ripple.

Thermal Shutdown

Thermal shutdown is employed to protect the device damage from the junction temperature exceed safe margins due mainly to short circuit or current limit. Moreover, the device returns normally operation when the junction temperature down to a constant temperature. Though temperature protection circuit is built in to protect IC, the maximum power dissipation design within Tj(max) is needed. The thermal protection is independent to each channel.

Thermal Consideration

The power handling capability of the device will be limited by maximum 125°C operation junction temperature. The power dissipated by the device will be estimated by

$$P_D = I_{OUT} \times (V_{IN}-V_{OUT})$$

The power dissipation should be lower than the maximum power dissipation listed in "Absolute Maximum Ratings" section.

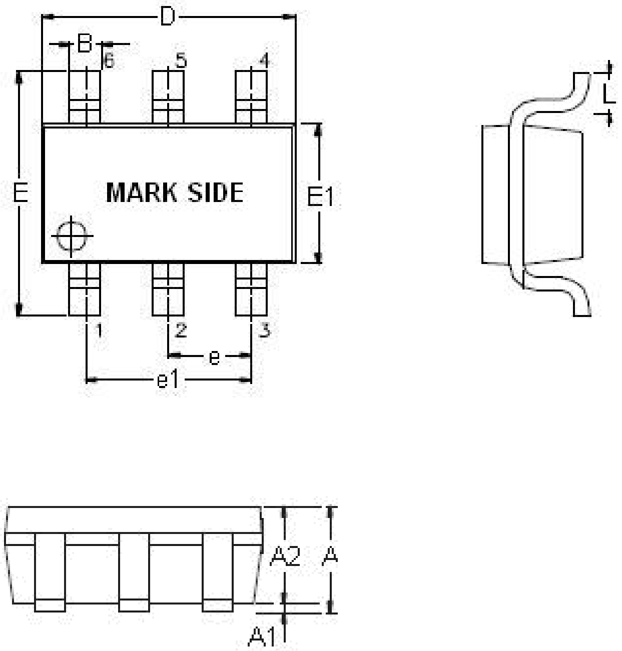
Capacitor Selection

The ceramic capacitor is ideal for FP6121 application. The ESR of the output capacitor affects stability. Larger value of the output capacitor decreases the peak deviations and improves transient response for larger current changes.

The capacitor types (ceramic, aluminum, and tantalum) have different characterizations such as voltage and temperature coefficients. All ceramic capacitors are manufactured with a variety of dielectrics, each with different behavior across temperature and applications. Common dielectrics used are X5R, X7R and Y5V. It is recommended to use 1μF to 10μF X5R or X7R dielectric ceramic capacitors because X5R or X7R hold their capacitance over wide voltage and temperature ranges than other Y5V or Z5U types. The ESR of output capacitor is very important because it generates a zero to provide phase lead for loop stability. The input capacitor can reduced peak current and noise at power source.

Outline Information

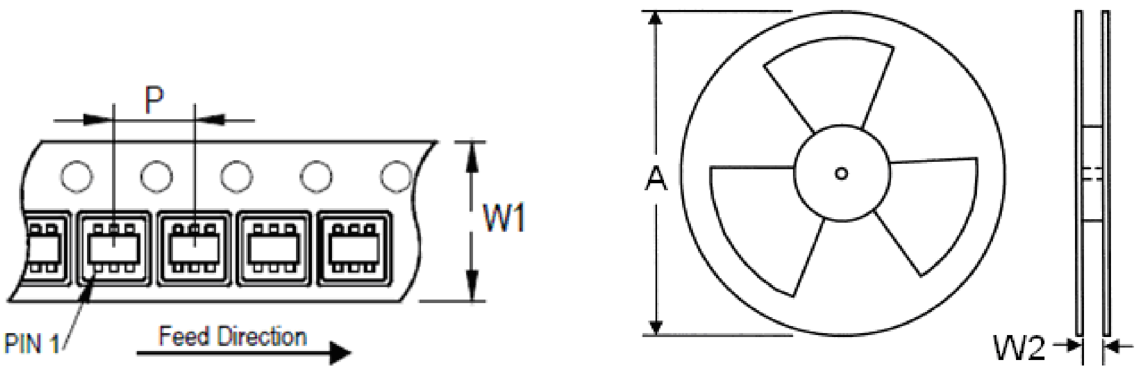
SOT-23-6 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
B	0.30	0.50
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.90	1.00
e1	1.80	2.00
L	0.30	0.60

Note：Followed From JEDEC MO-178-C.

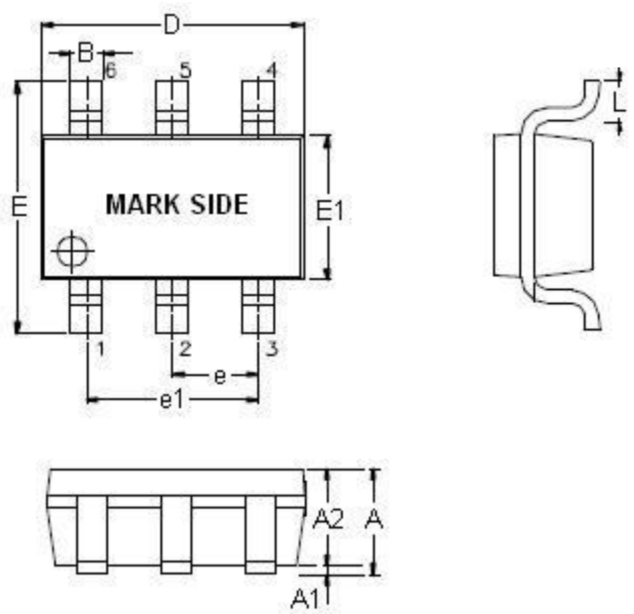
Carrier Dimensions



Tape Size (W1) mm	Pocket Pitch (P) mm	Reel Size (A)		Reel Width (W2) mm	Empty Cavity Length mm	Units per Reel
		in	mm			
8	4	7	180	8.4	300~1000	3,000

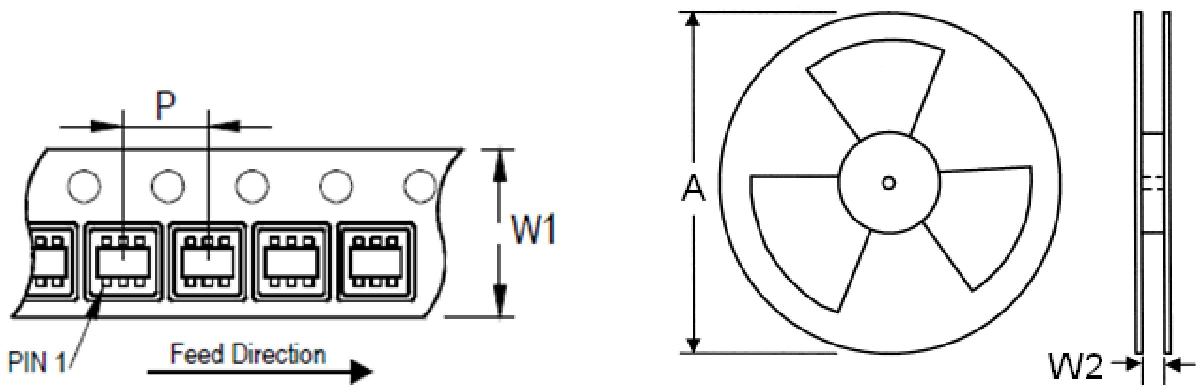
Outline Information (Continued)

TSOT-23-6 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.70	0.90
A1	0.00	0.10
A2	0.70	1.00
B	0.30	0.50
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.90	1.00
e1	1.80	2.00
L	0.30	0.60

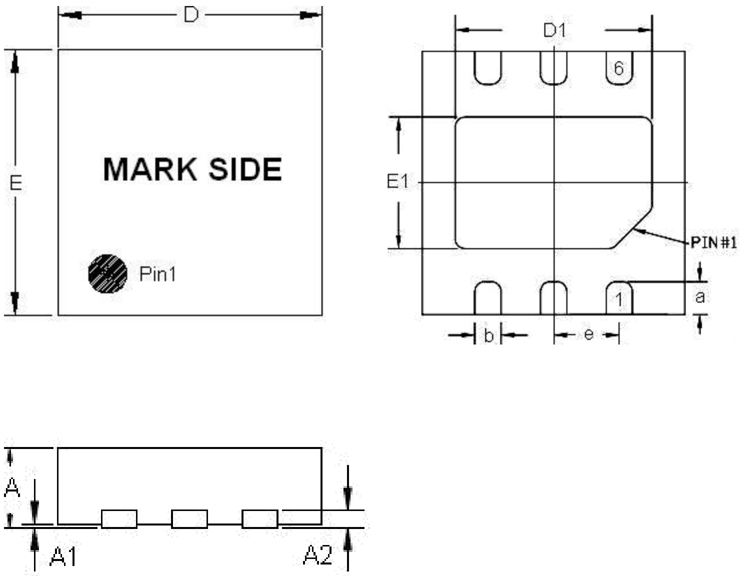
Carrier Dimensions



Tape Size (W1) mm	Pocket Pitch (P) mm	Reel Size (A)		Reel Width (W2) mm	Empty Cavity Length mm	Units per Reel
		in	mm			
8	4	7	180	8.4	300~1000	3,000

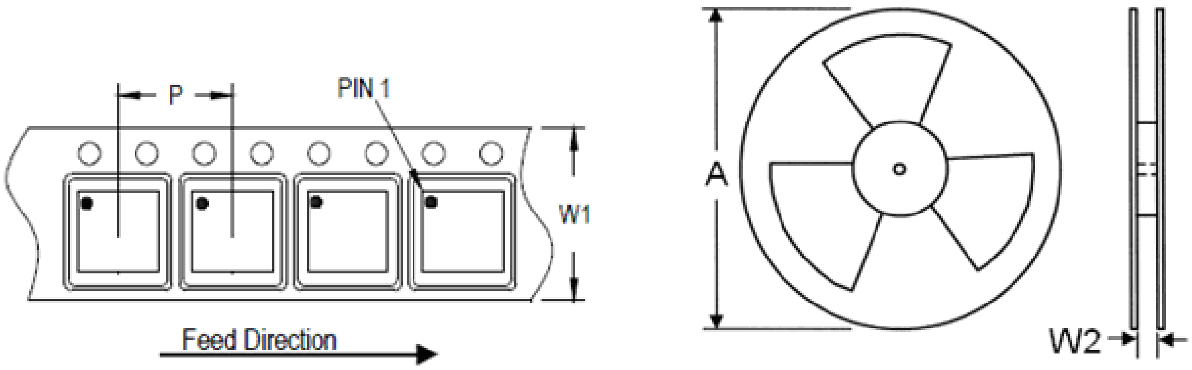
Outline Information (Continued)

TDFN-6 1.6mm×1.6mm Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A2	0.18	0.25
D	1.55	1.65
E	1.55	1.65
a	0.18	0.30
b	0.18	0.30
e	0.45	0.55
D1	0.95	1.05
E1	0.55	0.65

Carrier Dimensions



Tape Size (W1) mm	Pocket Pitch (P) mm	Reel Size (A)		Reel Width (W2) mm	Empty Cavity Length mm	Units per Reel
		in	mm			
8	4	7	180	8.4	400~1000	3,000